

## **Particularities of using energy-efficient glazing in Russia**

Mr. Alexandre G. Tchesnokov, Chief of standardization and testing department, Institute of Glass (GRI),

Mr. Stanislav A. Tchesnokov, Post-graduate student, Moscow Engineering-Physical Institute (MEPhI)

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### **Abstract**

When energy-efficient glazing of buildings and constructions using in Russia it is necessary to take into account a number of climatic particularities of given region:

- greater swings of temperatures during the year ( $-50 \div +50$  °C) that can cause the greater deformation an IGUs, bring about their being frozen through and fogging up;
- a defect of natural illuminating in autumn-winter period that requires use an glasses with the high factor of drive of light;
- a high solar activity at a spring period, bringing about the heating of glazing and big swings of temperatures on the glass thickness and between refreshed and unlighted areas that requires a reducing a factor of absorbing a solar energy for preventing a destroying glass.

For the analysis of heat and optical features of glazing variants in SC "GRI" is used program complex, based on ISO and Russia standards, allowing calculate factors of drive and absorbing a light, drives and absorbing a solar energy, the temperatures distribution on the thickness of glazing, thermal resistance. This complex is used both when designing the new buildings and constructions, so and at the expert operation of reasons of destroying glasses in existing.

### **Introduction**

In the past, on territory former USSR for light-transparent constructions practically only transparent glazing from 1 - 3 sheets of a transparent flat glass by a thickness of 4-6 mm was used. However recently, in the russian market all spectrum of articles from a glass of building assignment represented: laminated, low-emissivity, decorative, painted, hardened and other kinds of glasses, all widespread kinds of insulated glass units. The potential possibilities of new kinds of glasses, offered in the market, call large interest in the developers, stimulate demand of the consumers.

At the same time, neither the developers, nor at the consumers in Russia do not have experience of application of new materials. It results that the consumers do not have submission about what consequences can result choice inappropriate to the operating conditions glazing in, and the developers suppose errors connected to choice of glasses, which do not maintain specific features of operation in a concrete building. Quite often actual consumer qualities already installed glazing differ from properties, required by the consumer, or planned by the developer.

Certainly, the suppliers of a glass offer the recommendations for their operation, however these recommendations, as a rule, do not take into account particularities of operation of offered items in Russia. Besides at the consumers some doubt in conscientiousness of offered advertising quite often is exhibited.

Thus, one from main requests of the russian market became creation of an independent system rendering the consulting help to the developers and the consumers, lifting their common technological level. This system should be supplied with means, which would allow predicting consequences of application of those or other glasses in the concrete project of the building.

## The main frame

The specific particularities of glazing application in Russia consist in the following:

- The climatic features, which require the account of all parameters of an environment round a designed or existing building (range of air temperatures, pressure differentials, distribution of solar intensity, mechanical loads of a wind and snow etc.);
- The structure of a supply and demand for construction of new buildings and replacement of glazing in existing buildings, as the architectural projects the taking into account wishes of the consumers, quite often contain glazing variants, inappropriate to the operating conditions, for example, is very fashionable to use large light-transparency construction with the blacked out glass;
- The existence of the strict norms on heat saving, which observance requires use specially adapted glazing (for example, containing low-emissivity glass).

When energy-efficient glazing of buildings and structures use in Russia, it is necessary to take into account a number of climatic particularities of the given region:

- Large swing of temperatures during the year (-50 +50 °C), that can cause large glazing strains, result in their freezing and fogging;
- The defect of natural illumination in autumn-winter period, that requires use of glasses with high factor of light transmittance;
- The high solar activity in spring period causing to heat of glazing and large swings of temperatures on a thickness and between the covered and not covered areas, that requires decrease of an absorption coefficient of a solar energy for prevention of destruction of a glass.

The large swings of temperatures during the year are one from the most essential factors of IGU's operation in Russia. In practice there is a frequently situation, when temperature and, accordingly, pressure in gas space between glasses of IGU so hardly differ from conditions, in which it is made, that it results in an essential modification of consumer properties.

Cases are most distributed, when during winter in conditions of low temperatures of environment temperature and pressure in gas space becomes much less significance, allowable for normal operation. In this case sheets of a glass hardly bend towards one another. Such situation quite often arises of IGUs operation from a simple flat external glass and low-emissivity internal glass (because of lower temperature in gas space, than use of two usual glasses). As a rule, such IGU either fogging, or freezing, that naturally has an effect on a transparency and comfort indoors. However, in the worse case, such situation threatens with destruction of IGU from redundant deformations.

Taking into account, what not all manufacturers of IGU in Russia observe a temperature mode by assembly of the items in winter conditions, it happen also to collide with cases of depressurization already installed IGUs because of increase of temperature of an air in the summer. In the time of it in gas space of IGU the pressure grows.

The defect of natural illumination in autumn-winter period results in increased requirements to a transparency of glazing, which come in an inconsistency with an architectural intention of the developers and desire of their customers, which ensure effective demand. The choice of glazing with a low transmittance results in significant growth of costs on illumination, which can exceed scheduled, and contradicts Building norms and rules (BN&R). At the same time, the excessive absorption of a solar energy by glazing results in conditions of Russia in much more serious consequences in the spring.

The high solar activity in vernal period results in heat of the sunlit parts of glazing, origin of large swings of temperatures on a glazing thickness and between the sunlit and shadowed areas of glazing. The similar effect on glazing can cause destruction of IGU for several reasons: redundant deformation or strains originating by thermal expansion of a glass with a high absorption; the strains originating on the boundary sunlit and not sunlit areas etc. Unfortunately, that each spring in Moscow and other regions of Russia, in which there is an active construction, the set of cases of destruction installed in autumn-winter period IGUs with tone glass, and mainly on the solar party of buildings is observed.

The so pitiful position is determined, first of all, not by unconscientiousness of the suppliers of a glass or glazing, and absence at the developers and building organisations of experience of use of materials, new to them. The essential support to the given sector of the market of building materials should be

given by an independent consulting system, which would help to predict consequences of application those or others component in glazing of a specific building and to offer safe in operation solutions, which would correspond to the requests of the consumer, for example, tempered glass. In joint-stock company "GRI" such service acts and the assists building organisations, mainly in Moscow.

First step on a path of creation of the given system in scales of Russia should become creation of normative basis on application of modern constructions and materials for glazing. Already now there is a development new and revision of the old standards on many kinds of a glass and articles from it.

However direct help to the designers and consumers could render a certain program complex, which would allow with the help of modelling to predict all parameters of designed glazing and correspondence of these parameters to the prospective operating conditions. That is it would be desirable, that it was possible beforehand to determine - whether it is possible to use this or that construction of glazing in the given project and to receive the recommendations for possible paths of the co-ordination of necessary consumer properties and operating conditions at the expense of correct choice of glazing parameters.

The solution of this problem somewhat is helped by availability of large number of the international standards and domestic BN&R, which allow to determine a number of characteristics of glazing variants on some basic data and without a direct measurement. Their defect is the weak connection among themselves. Among the standards ISO and CEN it is necessary to mention the following:

- ISO 9050:1990 "Glass in building - Determination of light transmittance, solar direct transmittance, total solar energy transmittance and ultraviolet transmittance, and related glazing factors";
- ISO 10292:1994 "Glass in building - Calculation of steady-state U values (thermal transmittance) of multiple glazing";
- prEN 673 "Thermal insulation of glazing - Calculation rules for determining the steady state "U" value (thermal transmittance) of glazing";
- prEN 410 "Glass in building - determination of light transmittance, solar direct transmittance, total solar energy transmittance and ultraviolet transmittance, and related glazing characteristics".

With the help of these standards it is possible to receive optical and thermal characteristics of glazing variants, having as initial data only characteristics of glasses and gases filling gas spaces in IGU. Despite of a simplicity of the model incorporated in them, the obtained thus characteristics are rather useful, but in complicated cases multispaces glazing or in the case of use of glasses with the special properties the divergence with results received from direct measurements nevertheless is too great. Moreover the model relating calculation of thermal characteristics, does not allow revealing a set of physical processes taking place in glazing and being decisive for their operation, for example, distribution of temperatures on a thickness of glazing. However, now software products using more complicated models practically are absent and they are unknown for broad stratum of the interested faces.

In particular, in joint-stock company "GRI" for the analysis of thermal and optical characteristics of glazing variants the program complex basing on the indicated standards ISO [1] and [2] and Russia is used and allow to calculate factors of a transmittance and an absorption of light, transmittance and absorption of a solar energy, distribution of temperatures on a glazing thickness, thermal resistance. This complex is used as under designing of new buildings and structures, and on examination of the reasons of destruction of glasses in existing. With the help of this complex it had grown possible to gather rather significant volume of calculations outcomes, the overwhelming majority from which was confirmed in practice. One from the most essential outcomes of data of calculations became that majority of glazing variants used in modern construction in Russia do not correspond to the norms, in particular, on a heat-shielding and factor of natural light exposure.

Now in joint-stock company "GRI" and MEPhI there is a work on complication a model of calculation and inclusion of the analysis of thermal and optical characteristics of glazing variants in more general problem of IGU modelling in a building as complicated system subjected effects of an external medium: deformation, thermal loads etc. It is supposed to create a system, which could, in an ideal demonstrate all condition of glazing, observed in practice, and would help with a high exactitude to

predict behaviour of a concrete glazing area in a building. By it on the basis of data on a glazing construction (characteristics of used glasses and gases, geometric parameters of a system) the characteristics of a glazing system in the actual and extreme operating conditions should settle up: resistance to heat transfer, distribution of temperatures on a glazing thickness, factor of a transmittance of light, absorption coefficient of a solar energy, strain in glass, sags of glasses, sound isolating ability and other.

There are also normative documents on calculation of other glazing parameters, in particular of sound insulation, but also in this area the practice requires complication of models for them of more full correspondence with actual processes.

## **Conclusion**

The new building technologies just begin a penetration on the Russian building market, which potential is very huge. However it is necessary to apply persevering gains to protect the consumers from a negative impression called by misapplication of broadest possibilities, granted by it. The practice of glazing application in Russia dictates the special approaches to designing and evaluation of working outcomes in area of glazing.

Certainly, the problem of modelling for designing is actual all over the world, however in Russia there are problems, with which did not collide yet on more developed and simple, in a sense of climatic conditions, markets. It is necessary to mark, that in practice in Russia there is such amount of diverse glazing variants, that the direct measurement of parameters even already of used variants is represented by a rather complicated measure. If to speak about planned constructions, the statement of full-scale experiments in existing conditions too hardly would lift the price of any project.

At the same time, without knowledge of parameters of glazing variants, offered in the market, it is impossible to observe the recently established high specifications on heat-saving and comfort in locations. The modern materials are capable to supply observance of these norms without the special complication of a construction, but the information on their dignities, defects and correct application should be accessible to the consumers and developers.

The main conclusion, which we have made in a course of spent researches, is that the developers should more attention give to essential consumer properties of glazing and observance of the standards and other norms. For want of it, certainly, it is not necessary to refuse all possible spillovers, which attract the consumer, but it is necessary to search for the compromise between operational possibilities, specifications, and desire of the customer. Already today it is possible to evaluate many parameters of glazing up to physical realization of it, that will allow avoiding gross errors and will replace absent in Russia, but so necessary experience.

## References

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